	TITLE	SPECIFICATION NO.
	MOTOR	VOLUME II B
		SECTION D
	DATA SHEET - C	REV NO. 00 DATE 08/09/2010
		SHEET 1 OF 7

LT MOTORS

A. GENERAL

1.	Manufacturer & Country of origin. (Shall be as per approved QA make)	
2.	Equipment driven by motor	
3.	Motor type	
4.	Quantity	

B. DESIGN AND PERFORMANCE DATA

1.	Frame size		
2.	Type of duty		
3.	Type of enclosure /Method of cooling/Degree of protection		
4.	Applicable standard to which motor generally conforms		
5.	Efficiency class as per IS 12615		
6.	(a)	Whether motor is flame proof	Yes/No
	(b)	If yes, the gas group to which it conforms as per IS:2148	
7.	Type of mounting		
8.	Direction of rotation as viewed from DE END__		
9.	Standard continuous rating at 40 deg.C. ambient temp. as per Indian Standard (KW)		
10.	Derated rating for specified normal condition i.e. 50 deg. C ambient temperature (KW)		
11.	Maximum continuous load demand of driven equipment in KW		
12.	Rated Voltage (volts)		
13.	Permissible variation of :		

NAME OF VENDOR				REV.	
			SEAL		
NAME	SIGNATURE	DATE			

	TITLE	SPECIFICATION NO.
BHEL	MOTOR DATA SHEET - C	VOLUME II B SECTION D REV NO. 00 DATE 08/09/2010 SHEET 2 OF 7

a. Voltage (Volts)

b. Frequency (Hz)

c. Combined voltage and frequency

14. Rated speed at rated voltage and frequency(RPM)

15. At rated Voltage and frequency:

a. Full load current

b. No load current

16. Power Factor at

a. 100% load

b. NO load

c. Starting.

17. Efficiency at rated voltage and frequrecy,

a. 100% load

b. 75% load

c. 50% load

18. Starting current (amps) at

a. 100 % voltage

b. 85% voltage

c. 80% voltage

19. Minimum permissible starting Voltage (Volts)

20. Starting time with minimum permissible voltage

a. Without driven equipment coupled

b. With driven equipment coupled

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

	TITLE	SPECIFICATION NO.
BHEL	MOTOR DATA SHEET - C	VOLUME II B SECTION D REV NO. 00 DATE 08/09/2010 SHEET 3 OF 7

21. Safe stall time with 100% and 110% of rated voltage

    a. From hot condition

    b. From cold condition

22. Torques :

    a. Starting torque at min. permissible voltage(kg-mtr.)

    b. Pull up torque at rated voltage.

    c. Pull out torque

    d. Min accelerating torque (kg.m) available

    e. Rated torque (kg.m)

23. Stator winding resistance per phase (ohms at 20 Deg.C.)

24. GD^2 value of motors

25. No of permissible successive starts when motor is in hot condition

26. Locked Rotor KVA Input

27. Locked Rotor KVA/KW

28. Vibration limit :Velocity (mm/s)

29. Noise level limit (dBA)

C. CONSTRUCTIONAL FEATURES

1. Stator winding insulation

    a. Class & Type

    b. Winding Insulation Process

    c. Tropicalised (Yes/No)

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	TITLE	SPECIFICATION NO.
BHEL	MOTOR DATA SHEET - C	VOLUME II B SECTION D REV NO. 00 DATE 08/09/2010 SHEET 4 OF 7

d. Temperature rise over specified maximum ambient temperature of 50 deg C

e. Method of temperature measurement

f. Stator winding connection

2. Main Terminal Box

a. Type

b. Location (viewed from NDE side)

c. Entry of cables(bottom/side)

d. Recommended cable size (To be matched with cable size envisaged by owner)

e. Fault level (MVA), Fault level duration (sec)

f. Cable glands & lugs details (shall be suitable for power cable)

3. Type of DE/NDE Bearing

4. Motor Paint shade

5. Weight of

a. Motor stator (KG)

b. Motor Rotor (KG)

c. Total weight (KG)

D. List of accessories.

1. Space Heaters (Applicable for 30 KW & above motor) (Nos./Power in watts/supply voltage)

2. Terminal Box for Space Heater (Yes/No)

3. Speed switch (Yes/No)
No of contacts and contact ratings of speed switch

NAME OF VENDOR			SEAL	REV.	
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	TITLE	SPECIFICATION NO.
	MOTOR	VOLUME II B
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		SHEET 5 OF 7

4. Insulation of bearing (Yes/No)

5. Noise reducer(Yes/No)

6. Grounding pads

   i) No and size on motor body

   ii) Nos on terminal Box

7. Vibration pads

   i) Nos and size

   ii) Location

8. Any other fitments

E. List of curves.

1. Torque speed characteristic of the motor

2. Thermal withstand characteristic

3. Starting. current Vs. Time

4. Starting. current Vs speed

5. P.F. and Effi. Vs Load

F. Additional Data to be filled for each rating of DC Motor

1. Rated armature voltage (Volt)

2. Rated field excitation (Amp)

3. Permissible % variation in voltage

4. Minimum Permissible Starting voltage (volt)

5. At rated voltage

   i) Full load Armature current.(Amp)

   ii) Full load Field current (Amp)

	TITLE	SPECIFICATION NO.
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iii) No load Armature current (Amp)

6. Full load Field current (Amp)

7. No load Aramature current (Amp)

8. Minimum permissible field current(Amp) to avoid overspeeding at

   i) Maximum permissible voltage

   ii) Rated voltage

   iii) Minimum Permissible Voltage

9. Resistance (indicative Values) in ohm

   i) Armature winding (Arm + IP + Series) at 25 deg.C

   ii) Field Winding at 25 deg. C

10. Inductance (indicative values)

    i) Armature winding

    ii) Field winding

11. Value of trimmer resistance (ohm) to be connected in series with the shunt field to obtain rated speed at

    i) 220 V DC

    ii) 250 V DC

    iii) 187 V DC

12. Value of the external resistance (ohm) required to be connected in series with armature during starting only

13. Technical data sheet for external resistance box

14. GA drawing of motor

15. Starting time calculation

NAME OF VENDOR			SEAL	REV.	
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	TITLE	SPECIFICATION NO.
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16. Starter resistance design calculation

17. Electrical connection diagram of motor

NAME OF VENDOR					
				REV.	
NAME	SIGNATURE	DATE	SEAL		

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE 1X800MW WANAKBORI TPS			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION TITLE			
	SHEET 1 OF 2		SYSTEM			ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	2	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
3.0	TESTS	1.ROUTINE, TYPE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1*		* NOTE -1 & NOTE-3
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	NOTE -1 & NOTE-3
	BHEL		**PARTICULARS**		**BIDDER/VENDOR**							
			NAME									
			SIGNATURE									

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE 1X800MW WANAKBORI TPS			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION : TITLE :			
		SHEET 2 OF 2	SYSTEM			ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	

NOTES:

1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE, TYPE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON. TYPE TEST CERTIFICATES ON SIMILAR RATING OF MOTOR SHALL BE FURNISHED FOR APPROVAL. TYPE TEST CERTIFICATE SHALL NOT BE OLDER THAN FIVE(5) YEARS FROM THE DATE OF INSPECTION, OTHERWISE TYPE TEST TO BE CONDUCTED FREE OF COST.

2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.

3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.

Legends for Inspection agency

1. BHEL/CUSTOMER
2. VENDOR (MOTOR MANUFACTURER)
3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)

P. PERFORM
W. WITNESS
V. VERIFY

BHEL	**PARTICULARS**	**BIDDER/VENDOR**
	NAME	
	SIGNATURE	
	DATE	BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE 1X800MW WANAKBORI TPS			SPECIFICATION : NUMBER :			
	SHEET 1 OF 9		BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
			SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.0	RAW MATERIAL & BOUGHT OUT CONTROL											
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	2	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVENT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	2	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVENT IS/	SUPPLIER'S TC	3	-	2	HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	3	-	2	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	2	

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE 1X800MW WANAKBORI TPS			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 2 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	MFG. DRG. SPEC.	RELEVANT IS	SUPPLIER'S TC	3	-	2	
		3. DIMENSIONS	MA	MEASUREMENT	100%	-DO-	MANUFR'S DRG.	LOG BOOK	3	-	2	
		4.INTERNAL FLAWS	CR	UT	-DO-	ASTM-A388	MANUFR'S SPEC. BHEL SPEC.	-DO-	3	2	1	FOR DIA OF 55 MM & ABOVE
1.6	SPACE HEATERS, CONNEC-TORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUFR'S DRG. SPEC.	MANUFR'S DRG. SPEC.	-DO-	3	-	2	
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	-DO-	3	-	2	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG./ SPEC.	MANUFR'S DRG. / SPEC.	-DO-	3	-	2	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-DO-	-DO-	INSP. REPORT	3	-	2	

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

BHEL	QUALITY PLAN		CUSTOMER :			PROJECT TITLE 1X800MW WANAKBORI TPS			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 3 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	NO VISUAL DEFECTS	INSPT. REPORT	3	-	2	
		2. OTHER CHARACTERISTICS	MA	TEST	SAMPLE	MANUF'S SPEC.	MANUF'S SPEC.	LOG BOOK AND OR SUPPLIER'S TC	3	-	2	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK	3	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG. .	MANUFR'S DRG.	-DO-	3	-	2	FOR MV MOTOR INSULA-TION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	-DO-	MANUF'S SPEC./ RELEVANT IS	RELEVANT IS	SUPPLIER'S TC	3	-	2	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	LOG BOOK	3*	-	2*	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY BHEL/CUSTOMER.
		2.ELECT. PROP, & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	RELEVANT IS/ BS OR OTHER STANDARDS	RELEVANT IS/ BS OR OTHER STANDARDS	SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3	-	2	

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN		CUSTOMER :			PROJECT 1X800MW WANAKBORI TPS			SPECIFICATION :			
						TITLE			NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 4 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2	
1.10	BEARINGS	1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG./ APPROVED DATASHEET	MANFR'S DRG./ APPROVED DATASHEET	-DO-	3	-	2	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	2	
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC./ BHEL SPEC.	MANUF'S SPEC./ BHEL SPEC.	-DO-	3	-	2	
		4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	2	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	3	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE 1X800MW WANAKBORI TPS			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 5 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	2	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	2	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVENT SPEC./ ASTM-E165	MANUFR'S SPEC./ BHEL SPEC./	-DO-	2	-	1	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC/BHEL SPEC./ RELEVANT STAND	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	2	-	-	
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	2	-	-	

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN		CUSTOMER :			PROJECT 1X800MW WANAKBORI TPS TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 6 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-	
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1	(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	-	-	
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	FOR MV MOTOR
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-	
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-	
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	THREE DIPS TO BE GIVEN

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE 1X800MW WANAKBORI TPS	SPECIFICATION : NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
	SHEET 7 OF 9	SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
2.7	COMPLETE STATOR ASSEMBLY	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	-DO-	-DO-	-DO-	Log Book	2		1	
		3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2		1	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2		1	VERIFICATION FOR MV MOTOR ONLY
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2		1	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.AXIAL PLAY	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.DIMENSIONS	MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	2	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2		1	

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE 1X800MW WANAKBORI TPS	SPECIFICATION : NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
	SHEET 8 OF 9	SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10	10	10	11
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC.	MA	ELECT.TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	2	1*	1	* NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1$	1	$ NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1$	1	$ NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1$	1	$ NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1$	1	$ NOTE - 2
		8. NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1$	1	$ NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1$	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY $ NOTE - 2

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE 1X800MW WANAKBORI TPS			SPECIFICATION : NUMBER :		
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE		
	SHEET 9 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION	VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11

NOTES:

1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.

2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE, TYPE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON. TYPE TEST CERTIFICATES ON SIMILAR RATING OF MOTOR SHALL BE FURNISHED FOR APPROVAL. TYPE TEST CERTIFICATE SHALL NOT BE OLDER THAN FIVE(5) YEARS FROM THE DATE OF INSPECTION, OTHERWISE TYPE TEST TO BE CONDUCTED FREE OF COST.

3 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.

Legends for Inspection agency

1. BHEL/CUSTOMER
2. VENDOR (MOTOR MANUFACTURER)
3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)

P. PERFORM
W. WITNESS
V. VERIFY

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

EXPLANATORY NOTES FOR FILLING UP CABLE LIST FOR ROUTING THROUGH WINPATH

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

1. For the purpose of clarity, it may please be noted that the information given in regard to the cables to be routed through WinPath as per the system elaborated below is called "Cable List", while the term "Cable Schedule" applies to the cable list with routing information added after routing has been carried out.
2. The cable list shall be entered as an MS Excel file in the format as per enclosed template EXT_CAB_SCH_FORMAT.XLS. No blank lines, special characters, header, footer, lines, etc. shall be introduced in the file. No changes shall be made in the title line (first line) of the template.
3. The field properties shall be as under:
    a. UNITCABLENO: A/N, up to sixteen (16) characters; each cable shall have its own unique, unduplicated cable number. In case this rule is violated, the cable cannot be taken up for routing.
    b. FROM: A/N, up to sixty (60) characters; the "From" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
    c. TO: A/N, up to sixty (60) characters; the "To" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
    d. PURPOSE: A/N, up to sixty (60) characters; the purpose (i.e. power cable/ indication/ measurement, etc.) to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
    e. REMARKS: A/N, up to forty (40) characters; Any information pertinent to routing to be specified here (e.g., cable number of the cable redundant to the cable number being entered). Information in excess of 40 characters will be truncated after 40 characters.
    f. CABLESIZE: A/N, 7 characters exactly as per the codes indicated below shall be specified here. The program cannot route cables described in any other way/ format.
    g. PATHCABLENO: Field reserved for utilization by the program. User shall not enter any information here.
4. One list shall be prepared for each system/ equipment (i.e., separate and unique cable lists shall be prepared for each system).
5. The cables shall be described as per the scheme listed below:

A	NN	A	NNN
|	|	|	|
Cable Voltage Code (see B below)	No. of cores (e.g. 01,03,3H, 07)	Cable code (See C below)	Cable size (e.g. 035,185,2.5, 0.5)

(A) SYSTEM VOLTAGE CODES:
(ac) A = 11KV, B = 6.6KV, C = 3.3KV, D = 415V, E = 240V, F = 110V
(dc) G = 220V, H = 110V, J = 48V, K = +24V, L = -24V

(B) CABLE VOLTAGE CODES:
A = 11KV (Power cables)

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

B = 6.6KV (Power cables)
C = 3.3KV (Power cables)
D = 1.1KV (LV & DC system power & control cables)
E = 0.6KV (0.5 sq. mm. Control cables)

(C) CABLE CODES

PVC Copper

A = Armoured FRLS	B = Armoured Non-FRLS
C = unarmoured FRLS	D = Unarmoured Non-FRLS

PVC Aluminium

E = Armoured FRLS	F = Armoured Non-FRLS
G = unarmoured FRLS	H = Unarmoured Non-FRLS

XLPE Copper

J = Armoured FRLS	K = Armoured Non-FRLS
L = unarmoured FRLS	M = Unarmoured Non-FRLS

XLPE Aluminium

N = Armoured FRLS	P = Armoured Non-FRLS
Q = unarmoured FRLS	R = Unarmoured Non-FRLS

S = FIRE SURVIVAL CABLES
T = TOUGH RUBBER SHEATH
U = OVERALL SCREENED
V = PAIRED OVERALL SCREENED
W = PAIRED INDIVIDUAL SCREENED
Y = COMPENSATING CABLES
I = PRE-FABRICATED CABLES
Z = JELLY FILLED CABLES

SECTION-C4
TECHNICAL SPECIFICATION
(C&I PORTION)

CONTROL AND INSTRUMENTATION SPECIFICATION FOR CONDENSATE POLISHING UNIT

DESIGN	VKV
CHECKED	SCS
APPROVED	SCS
DATE	05.06.15
REV.	00

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GENERAL & SPECIFIC TECHNICAL REQUIREMENT

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

GENERAL REQUIREMENT

1.0 Bidder shall provide complete and independent control & instrumentation system with all accessories, auxiliaries and associated equipments for the safe, efficient and reliable operation of auxiliary systems.

2.0. The quantity of instruments for auxiliary system shall be as per tender P &ID, wherever provided, for the respective system as a minimum for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe &reliable operation of plant, bidder shall supply the same without any price implication.

3.0 Measuring instruments/equipment and subsystems offered by the bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further all the instruments shall be of proven reliability, accuracy, and acceptable international standards and shall be subject to employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specification, ranges, makes/ numbers as approved by the employer' during detail engineering.

4.0 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/ erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments; sensors, switches etc for external connection including spare contacts shall be wired out to suitably located junction boxes.

5.0 In case of any contradiction most stringent clause/condition shall prevail.

Specific Technical Requirements (C&I):

The control of CPU shall be through PLC based control system having hot redundant Central Processing Unit. The operation and control philosophy of CPU has been elaborated in separate section in the specification. The PLC shall be located in Control Room in Regeneration area. One (1) nos. OWS(Operator Works Station) and one(1) no. OEWS(Operator cum Engineering Work Station) with 24" colour TFT monitor ,one(01) no. A3 size color laser printer and one (01) no.A3 size dot matrix printer, keyboard, mouse etc. shall be provided by the bidder. OWS/EWS shall be provided with anti-glare coating. Remote I/O panel with mimic on the control panel shall be provided in the service vessel area. In addition to OWS operation, hardware based monitoring / control / annunciation shall be provided for the systems where HMI workstations are not envisaged or need for such back up is strongly recommended by Bidder for the safe shutdown of the system. The Complete PLC based control system with OWS, Laptop, Remote I/Os, Printer, UPS (for PLC, OWS, Remote I/Os, Printer,mimic etc.), desk along with furniture shall be in Bidder's scope. PC for OWS shall be of workstation grade. Additional laptop loaded with engineering software shall be provided.

2) The communication between PLC and Main plant DCS shall be OPC compliant (Data Access 2.0) TCP/IP on Fibre Optic link. The communication link between PLC and Main plant DCS shall be redundant. The necessary hardware/software including LIU (Light Interface unit) at PLC end shall be in Bidder's scope. Repeaters, if required for interfacing shall also be provided by the bidder. For communication between main plant DCS and PLC, the PLC end shall be considered as server and DCS shall be considered as client.

3) PLC control system shall be time synchronized with the Master clock system of the main plant to ensure uniform time indication throughout the Plant. The required provision (IRIG-B) shall be made by the bidder at the PLC end to achieve the same.

4) The software and hardware for offered PLC system shall be of latest version and shall be upgradable. Bidder to ensure the availability of spares and service support for the offered PLC system for minimum 20 years after guarantee period. The software tool shall have facility to interface with third party software packages. Easy up gradation and future expansion facility shall be available. All softwares used shall be licensed versions only. All software user licenses shall be valid for entire life of power plant and shall be in the name of customer. User shall not have to pay any recurring license fee during the usage period of the system.
It shall be possible to upgrade the installed system with the latest available version of the software model during the plant life.

5) All electrical actuators shall be non-integral type.

6) The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.

7) The solenoid valves shall have limit switches for open/close feedback.

8) Interface of MCC, HT SWGR,Actuators etc. with PLC based control system shall be as per Drive Control Philosophy attached in the specification. The attached philosophy is for DCS based control system. However, the same is applicable for PLC as well.

9) All the instruments/drives shall be terminated on JBs/Panels in field. JBs/Panels shall be in Bidder's scope. RTD's shall be of duplex type.

10) Scope of Instrumentation cables (Screened Control Cables), Fibre Optic cable & Control cables shall be as per Electrical Cable scope matrix in Electrical portion of specification. Any cable in Bidder's scope shall be as per specification.

11) UPS for PLC, OWS etc. shall be in bidder's scope with 2X100% configuration along with SVS(Static Voltage Stabiliser). UPS shall have 2X100%, VRLA type battery bank with 60 min back up. For further details UPS specification attached elsewhere shall be referred. Redundant UPS power supply shall be extended to PLC, RIO etc.

12) Bidder shall provide Customer training on the proper application and maintenance of PLC Hardware & Software at Vendor's work or at Wanakbori site.

13) Following documents to be furnished by the bidder along with the bid:

- Proposed PLC system configuration drawing with write-up
- Duly stamped and signed copy of Quality Plan.
- Product catalogues and specifications for PLC as well as HMI application.
- Requirement of electronic earthing, if any, for PLC based control system

14) Ergonomically & aesthetically designed furniture viz. control desks & Chairs shall be provided for workstations, programming stations, PCs and various peripherals at control room/computer room/equipment room. Furniture

shall include documentation racks, tables for laydown etc. Control Desk profile shall be in line with drawing K9213R-DWG-I-0161.

15) Bidder to comply with codes and standards as mentioned in the specification.

16) All local gauges, transmitters and switches shall be mounted on suitable enclosures, racks subject to owner's approval. All transmitters shall be HART compatible.

17) Bidder to delegate /depute their persons/experts as per owner/consultants' requirement.

18) Bidder must offer general tools and tackles and special calibration instruments required during start-up, trial run, operation and maintenance of the system.

19) The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by bidder without any technical, commercial and delivery implication to BHEL.

1.00.00 **GENERAL**

1.01.00 In conformity with the guidelines provided in the specification, the scope of works shall completely cover all Instrumentation & Control equipment, functions, activities and documentation specified under the accompanying Technical Specifications and shall not be limited to the following:

a) Detailed design and engineering of the manufactured equipment; system integration and system engineering.

b) Complete manufacture including shop testing before shipment.

c) Specifying, procurement, quality inspection of bought-out items from sub-suppliers. Design co-ordination for and integration with bought-out items.

d) Coordination, integration and interface between various BOP control systems such as Water Pretreatment plant, Demineralized Water plant, Coal Handling Plant, Ash Handling Plant, ETP etc. and the station DCS for centralized monitoring & selective operation.

e) Providing engineering drawings, documents, licensed copy of software and developmental tools, data, instruction, operation and maintenance manual etc. for Owner's review / approval / record.

f) Arranging for Owner's inspection and testing of manufactured as well as bought-out items at the respective works.

g) Packaging and transportation of instruments, equipments, accessories and erection hardware from the manufacturer's works to the site, including transit insurance.

h) Pre-assembly (if any), erection, testing and commissioning of all equipments and instruments supplied, in totality.

i) Performing availability tests, Performance and Guarantee tests.

j) Prepare and submit approved & as-built drawings and documents in hard and soft copies.

k) Furnishing of spares, tools and tackle and test instruments.

l) Fulfilling post-commissioning liabilities.

m) Arranging for the training of Owner's personnel of different categories at manufacturer's works as well as plant site.

n) Other activities detailed in subsequent sections of the Specification.

o) Any other activity, not mentioned explicitly, but felt essential by Bidder for successful completion of work.

1.02.00 Requirements enumerated in this specification are qualitative in nature and are based on typical configuration of various BOP plants for the purpose of bidding. It shall be the responsibility of Bidder to offer Instrumentation &

Control system to meet the actual functional requirements of the BOP systems offered.

1.03.00 Operation and control of various BOP systems like Water system, Coal Handling plant, Ash Handling plant, Compressed air system, Ventilation & AC system, DM plant, PT plant,CW treatment system, DG set, , Fuel unloading system etc. shall be carried out from redundant PLC / Microprocessor based control system. There may be other systems where control is not critical. In such cases hardwired / relay based interlock shall be envisaged.

However, hardware based monitoring / control / annunciation shall be provided for the systems where HMI workstations are not envisaged or need for such back up is strongly recommended by Bidder for the safe shutdown of the BOP systems.

1.04.00 In case of any conflict or contradiction between any two or more sections of this specification the more stringent condition shall generally be applicable. Owner, however, reserves the right to relax this condition at his discretion.

1.05.00 Type of control vis-a vis the plant area are delineated below

1.05.01 Plant Auxiliaries System:

a) DM Cooling Water System & process Heat exchangers

b) Condenser Cooling Water (CW system) with tube cleaning system.

c) Auxiliary Cooling Water System (ACW system) with self-cleaning strainers.

d) Condensate Transfer (CT) pump

e) DM Service Water (DMSW) pumps

f) Mill Reject Handling System

g) Fuel Oil Pressurizing & Heating System

h) Condensate On-line Polishing Unit

i) Chemical Feed system

1.05.02 Interface with Other Off site Plants under BOP Package

Data acquisition / indication of selected parameters / selective operation (as required) from the following off site plants to station DCS are foreseen through MODBUS / OPC protocol:

a) Pretreatment Plant;

b) Demineralization Plant;

c) Coal Handling plant;

d) Fuel Oil Unloading & Storage;

e) Turbine Oil Purification system;

f) ETP Plant;

g) Ash Handling Plant;

h) Fire sensing and protection system;

i) Compressed air system;

j) AC & Ventilation System.

1.05.03 Off Site Plants shall be operated from their local control stations located in the respective plant local control rooms. Some of the Plants shall have limited operational facility from Central Control Room as well.

1.05.04 All PLC based based control systems for plant auxiliaries and other offsite plants shall be powered from separate redundant UPS. Local control panels for such systems shall be kept in air condition environment.

1.05.05 Control matricx for the Auxiliaary system & off-site systems shall be in general as below:

SL. NO.	AUX.SYSTEM / PLANT	CONTROL SYSTEM	CONTROL LOCATION	DCS INTERFACE
A.	**Plant Auxiliaries System**			
a)	DM Cooling Water System (Turbine)	DCS	DCS Monitoring & Operation from Central Control Room	
b)	DM Cooling Water System (Boiler)	DCS	DCS Monitoring & Operation from Central Control Room	
c)	CW system	Through Remote I/O Cabinet to DCS	DCS Monitoring & Operation from Central Control Room	
d)	ACW system	Through Remote I/O Cabinet to DCS	DCS Monitoring & Operation from Central Control Room	
e)	Condenser tube cleaning system	PLC	Local operating panel .	Hardware connectivity for alarm and monitoring.
f)	Mill Reject Handling	Redundant PLC	Operator stations in local	MODBUS Soft link for remote

SL. NO.	AUX.SYSTEM / PLANT	CONTROL SYSTEM	CONTROL LOCATION	DCS INTERFACE
			Control Room	monitoring
f)	Instrument Air & Service Air Compressors & air drying plant	Microprocessor based control for each compressor with master controller	Individual unit with operator interface & PC based master Operating Staion with 24" TFT monitor in Compressor Room.	MODBUS Soft link for remote monitoring
g)	Fire sensing and protection system for Entire Plant.	Microprocessor based Intelligent Detectors & PLC based Fire Water Pump control System	Microprocessor based Main Fire Alarm Panel in Control Room & Loacl panel in Fire Water Pump House. One repeater Fire Alarm Panel in existing Fire Station and depending on distance cabling interface shall be decided by Bidder.	Hard wired interface to DCS for monitoring and status indication.
h)	Pretreatment Plant	Redundant PLC	Within the boundary limit of PTPlant	MODBUS Soft link for remote monitoring

NOTE: As per concept of integration of control system Bidder may consider propriatory control systems as integrated part of DCS.

1.05.06 Considering the high ambient noise and electromagnetic interference prevailing in power plant, communication links between off-site controls and plant DCS shall be based on Optical Fiber Communication (OFC) alog with necessary hardware at both ends.

2.00.00 **DESIGN PHILOSOPHY**

2.01.00 General design philosophy outlined in Vol IIE Section 1 of the specification shall apply to plant auxiliaries as well.

2.02.00 PLC systems shall be time synchronized with the GPS Master Clock. Bidder shall arrange for the necessary ports ans cable for the purpose as well.

3.00.00 **INSTRUMENT & SYSTEM PHILOSOPHY**

3.01.00 Fuel Oil Pressurising & Heating System

C&I DELIVERABLES LIST

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT							
1X800 MW WANAKBORI TPP							
DOCUMENT NUMBER PE-GL-408-145-I100							
Sl.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY	CUSTOMER	FROM	USER	REMARKS
INSTRUMENTATION							
1	PE-V9-408-XXX-I901	INSTRUMENT DATA SHEETS	A	-	VENDOR	C&I	
2	PE-V9-408-XXX-I902	INSTRUMENT SCHEDULE	I	-	VENDOR	C&I	
3	PE-V9-408-XXX-I903	INSTRUMENT INSTALLATION/ HOOK UP DIAGRAMS	A	-	VENDOR	C&I	
4	PE-V9-408-XXX-I904	FIELD JB TERMINATIONS /GROUPING DOCUMENT	I	-	VENDOR	C&I	
5	PE-V9-408-XXX-I905	QUALITY PLANS (CV,FE, Tx and Analyser)	A	-	VENDOR	C&I	
PLC PANEL							
1	PE-V9-408-XXX-I906	PLC CONFIGURATION DRAWING	A	A	VENDOR	C&I	
2	PE-V9-408-XXX-I907	PLC PANEL GA (INTERNAL & EXTERNAL) DRAWING	A	-	VENDOR	C&I	
3	PE-V9-408-XXX-I908	CONTROL SCHEMES (BLOCK LOGIC)	A	-	VENDOR	C&I	
4	PE-V9-408-XXX-I909	PLC INPUT / OUTPUT SIGNAL LIST	I	-	VENDOR	C&I	
5	PE-V9-408-XXX-I910	UPS BATTERY CHARGER/ BATTERY DATASHEET & SLD	I	$$	VENDOR	C&I	
6	PE-V9-408-XXX-I911	UPS SIZING CALCULATIONS	I	-	VENDOR	C&I	
7	PE-V9-408-XXX-I912	BATTERY SIZING CALCULATIONS	I	-	VENDOR	C&I	
8	PE-V9-408-XXX-I913	CONTROL DESK LAYOUT / GA DRAWING	A	-	VENDOR	C&I	
9	PE-V9-408-XXX-I914	PLC-OWS/PRINTER FURNITURE BOM	A	-	VENDOR	C&I	
10	PE-V9-408-XXX-I915	PLC CONTROL ROOM LAYOUT DRAWING	A	-	VENDOR	C&I	
11	PE-V9-408-XXX-I916	PLC CATALOGUE	I	-	VENDOR	C&I	
12	PE-V9-408-XXX-I917	PLC QUALITY PLAN & FAT PROCEDURE	A	-	VENDOR	C&I	
13	PE-V9-408-XXX-I918	LIST OF SIGNAL EXCHANGE WITH DDCMIS (BOTH HARDWIRED & SERIAL INTERFACE IN BHEL FORMAT)	A	`	VENDOR	C&I	
14	PE-V9-408-XXX-I919	PROCESS GRAPHIC MANUSCRIPTS PLC	I	-	VENDOR	C&I	
15	PE-V9-408-XXX-I920	PROCESS GRAPHIC MANUSCRIPTS FOR DDCMIS	I	-	VENDOR	C&I	
16	PE-V9-408-XXX-I921	CABLE SCHEDULE (IN BHEL EXCEL FORMAT) & CABLE INTERCONNECTION DETAILS	I	-	VENDOR	C&I	
17	PE-V9-408-XXX-I923	PANEL & ELECTRONIC EARTHING REQUIREMENT	I	-	VENDOR	C&I	
18	PE-V9-408-XXX-I924	PANEL HEAT DISSIPATION DATA	I	-	VENDOR	C&I	
19	PE-V9-408-XXX-I925	MANDATORY SPARES BILL OF MATERIAL	A	A	VENDOR	C&I	
20	PE-V9-408-XXX-I926	PLC O & M MANUAL	I	-	VENDOR	C&I	
21	PE-V9-408-XXX-I927	PLC EARTHING SCHEME	I	-	VENDOR	C&I	
	Notes:	408 - Project No.					
		XXX -MAX Package Code					
		$$ -Approval by BHEL if Vendor BBU Item. Approval by Customer if Customer BBU Item					

SPECIFICATION FOR MOTORISED VALVE ACTUATOR

FORM NO. PEM-6666-0

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.: PE-ID-408-145-I902 VOLUME II B SECTION D REV. NO. 00 DATE: 04.04.15 SHEET 1 OF 3

Data Sheet A & B

408

		DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
GENERAL*	* PROJECT		
	OFFER REFERENCE		
	* TAG NO. SERVICE		
	* DUTY	☐ ON / OFF ☐ INCHING	
	* LINE SIZE (inlet/outlet): MATERIAL		
	* VALVE TYPE	☐ GLOBE ☐ GATE ☐ REG. GLOBE ☐ BUTTERFLY	
	* OPENING / CLOSING TIME		
	* WORKING PRESSURE		
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%	
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY	
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY	
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY	
CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF, IPW:55	
	MECHANICAL POSITION INDICATOR	TO BE PROVIDED FOR 0-100% TRAVEL	
	BEARINGS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.	
	GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION	METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.	
	SIZING	OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER **FOR INCHING SERVICE - 150 STARTS/HR MINIMUM & FOR REGULATING SERVICE - 600 STARTS/HR MINIMUM.**	
HANDWHEEL	* REQUIRED	■ YES ☐ NO	
	* ORIENTATION	☐ TOP MOUNTED ☐ SIDE MOUNTED	
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.		
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY	
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY	
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT-INCLUSIVE OF **I.S.** TOLERANCE	
	ACTUATOR APPLICABLE WIRING DIAGRAM	■ ENCLOSED (BIDDER TO CONFIRM) A: ☐ DRG. NO. 3-V-MISC-24227 R00 B: ☐ DRG. NO. 3-V-MISC-24550 R00 C: ☐ DRG. NO. 3-V-MISC-24283 R00 D: ■ DRG. NO. 4-V-MISC-90271 R11 E: ☐ For Thyristor based Integral starter, Bidder/Vendor to furnish wiring diagram	
	COLOUR SHADE	☐ BLUE (RAL 5012) ☐ ……. (TO BE DECIDED BY BHEL DURING DETAIL ENGG.)	
	PAINT TYPE **(## Refer Notes)**	☐ ENAMEL ☐ EPOXY ☐ ……. (TO BE DECIDED BY BHEL DURING DETAIL ENGG.)	
	SHAFT RPM	BIDDER TO SPECIFY	
	OLR SET VALUE	BIDDER TO SPECIFY	
	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY	
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY	

FORM NO. PEM-6666-0

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.: PE-ID-408-145-I902 VOLUME II B SECTION D REV. NO. 00 DATE: 04.04.15 SHEET 2 OF 3

Data Sheet A & B

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		DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC	
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ☐ 230 V ■ 110 V	
	@ ENCLOSURE CLASS OF MOTOR	■ IP 65 ☐ FLAME PROOF	
	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B	
	@ WINDING TEMP PROTECTION	■ THERMOSTAT (3 Nos.,1 IN EACH PHASE) ■ ---THERMOSTAT- 1 NO+1 NC CONTACT ----------	
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED	
INTEGRAL STARTER	INTEGRAL STARTER	☐ REQUIRED ■ NOT REQUIRED	
	TYPE OF SWITCHING DEVICE	☐ CONTACTORS ☐ THYRISTORS	
	TYPE	☐ CONVENTIONAL ☐ SMART (NON-INTRUSIVE)	
	IF SMART		
	a) SERIAL LINK INTERFACE	☐ INTEGRAL ☐ FIELD MOUNTED	
	b) SERIAL LINK PROTOCOL	☐ FOUNDATION FIELD-BUS ☐ PROFI-BUS ☐ DEVICE NET ☐.....	
	c) SERIAL LINK MEDIA	☐ TWISTED PAIR Cu-CBL ☐ CO-AXIAL Cu-CBL ☐ OFC	
	d) HAND HELD PROGRAMMER	☐ REQUIRED ☐ NOT REQUIRED	
	e) TYPE OF HAND HELD PROGRAMMER	☐ BLUETOOTH ☐ INFRARED ☐.....	
	f) MASTER STATION	☐ REQUIRED ☐ NOT REQUIRED	
	g) MASTER STN INTRFACE WITH DCS	☐ MODBUS ☐ TCP/IP	
	h) DETAILS OF SPECIAL CABLE	☐ ENCLOSED ☐ NOT REQUIRED	
	STEP DOWN CONT. TRANSFORMER	☐ REQUIRED	
	OPEN / CLOSE PB	☐ REQUIRED ☐ NOT REQUIRED	
	STOP PB	☐ REQUIRED ☐ NOT REQUIRED	
	INDICATING LAMPS	☐ REQUIRED ☐ NOT REQUIRED	
	LOCAL REMOTE S/S	☐REQUIRED ☐ NOT REQUIRED	
	STATUS CONTACTS FOR MONITORING	☐ REQUIRED ☐ NOT REQUIRED	
	INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, S/S IN LOCAL, TORQUE SWITCH OPTD. MID WAY)	
INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter)	TYPE OF ISOLATING DEVICE	☐ INTERPOSING RELAY ☐ OPTO COUPLER ☐ EITHER	
	QUANTITY	☐ 2 NOs. ☐ 3 NOs.	
	DRIVING VOLTAGE	■ 20.5 – 24V DC ☐ _____V DC	
	DRIVING CURRENT	■ 125mA MAX ☐ _____mA MAX	
	LOAD RESISTANCE	■ > 192 ohms - <25 k ohms ☐ > _____ohms - < _____ohms	
TORQUE SWITCH (Not Applicable for Smart Actuator) **($$ Refer Notes)**	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN / CLOSE	■1 No. ☐2Nos. / ■1 No. ☐2Nos	
	CONTACT TYPE	2 NO + 2 NC	
	RATING	5A 240V AC AND 0.5A 220V DC	
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE	
	ACCURACY	+3% OF SET VALUE	

FORM NO. PEM-6666-0

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.: PE-ID-408-145-I902 VOLUME II B SECTION D REV. NO. 00 DATE: 04.04.15 SHEET 3 OF 3

Data Sheet A & B

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		DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)		
LIMIT SWITCH (Not Applicable for Smart Actuator) **($$ Refer Notes)**	MFR & MODEL NO.	BIDDER TO SPECIFY					
	OPEN : INT : CLOSE	☐1 No ■2 Nos.	2 Nos. (ADJ.)	☐1 No. ■2Nos.			
	CONTACT TYPE	2 NO + 2 NC					
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC					
POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty & other specific applications)	■ REQUIRED ☐ NOT REQUIRED					
	MFR & MODEL NO.	BIDDER TO SPECIFY					
	TYPE	■ ELECTRONIC (2 WIRE) R/I CONVERTER ☐ ELECTRONIC (2 WIRE) CONTACTLESS					
	SUPPLY	■ 24V DC ☐					
	OUTPUT	■ 4-20mA					
	ACCURACY	± 1% FS					
SPACE HEATER	@SPACE HEATER	REQUIRED					
	@ POWER SUPPLY (NON INTEGRAL)	230V AC,1 PH.,50 Hz					
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY					
	@ RATING	decided as per load data received tender stage					
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED					
	ENCL CLASS ACTUATOR/MOTOR T.B.	@☐ IP 68 @☐.....					
	@ EARTHING TERMINAL	REQUIRED					
	PLUG & SOCKET(9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT)	☐ REQUIRED ☐ NOT REQUIRED☐ ☐ 2 NOS. ☐ ----------					
CABLE GLANDS	@ POWER CABLE GLAND	SIZE: decided as per load data received tender stage					
	@ SPACE HEATER CABLE GLAND	SIZE: decided as per load data received tender stage					
	OTHER CONTROL CABLE GLANDS-1	☐ 1No. for BFV of CW PUMP(Cable size 2Px1.5mm2)					
	OTHER CONTROL CABLE GLANDS-2	QUANTITY & SIZE :----------					

FORM NO. PEM-6666-0

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.: PE-ID-408-145-I902 VOLUME II B SECTION D REV. NO. 00 DATE: 04.04.15 SHEET 4 OF 3

Data Sheet A & B

DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)

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WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY	_____ Kg.

NOTES:

1. **SCOPE**: DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.
2. **CODES & STANDARDS**: DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATION STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH:
   IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722
3. TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
4. CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED.
5. THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION.THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE.
6. THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%.
7. THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.
8. CANOPY FOR OUTDOOR SERVICES SHALL BE PROVIDED.

$$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE.

EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.

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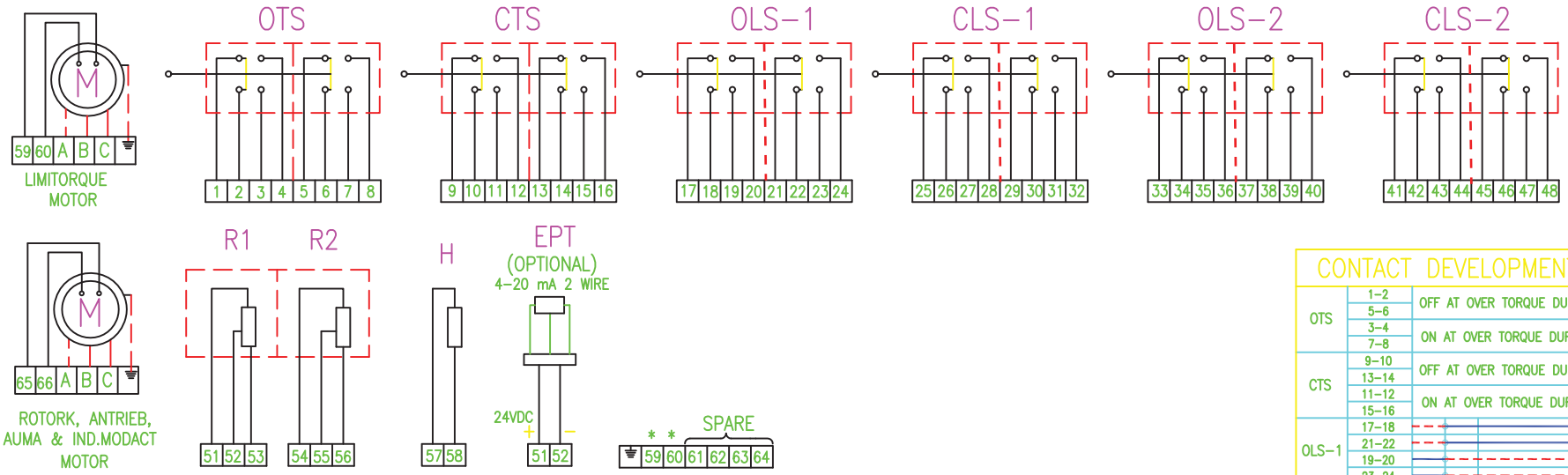
	PREPARED BY	CHECKED BY	APPROVED BY	VENDOR COMPANY SEAL
NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @= TO BE FILLED BY ES



* – SPARE FOR ROTORK, AUMA, ANTRIEB & IND.MODACT

SWITCHES – ALL ARE POTENTIAL FREE AND TWO PAIR OF CONTACTS CAN BE USED FOR DIFFERENT SUPPLY

THERMOSTAT – 65–66 (ROTORK, AUMA, ANTRIEB & IND.MODACT), 59–60 (LIMITORQUE).

EPT – ELECTRONIC POSITION TRAMSMITTER (POTENTIOMETRIC TYPE, FOR INCHING DUTY)

THERMOSTAT TERMINALS – TERMINATED IN MOTOR TB IN ANTRIEB & IND.MODACT AND IN MAIN TB IN OTHER MAKES

CTS – TORQUE SWITCHES FOR CW ROTATION (CLOSE) – 2 NO+2 NC

OTS – TORQUE SWITCHES FOR CCW ROTATION (OPEN) – 2 NO+2 NC

OLS–1, OLS–2 – LIMITSWITCHES FOR POSITION OPEN – 2 NO+2 NC

CLS–1, CLS–2 – LIMITSWITCHES FOR POSITION CLOSE – 2 NO+2 NC

OTS, CTS – TWO INDEPENDENT SWITCHS IN ANTRIEB & LIMITORQUE

OLS–2 & CLS–2 – CAM DISC IN ROTORK & ANTRIEB

R1–R2– POTENTIOMETER 2 x 100 OHMS

H – SPACE HEATER 1ø 240V AC SUPPLY

M – MOTOR 3ø 415V 50 Hz AC SUPPLY

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

VALVES	OPEN		CLOSE	
	MAIN	BACK UP	MAIN	BACK UP
GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS	CLS	CTS
ALL OTHER GATE & GLOBE VALVES	OLS	OTS	CTS	@

@ – CLS NOT TO BE CONNECTED IN TRIP CIRCUIT

NOTE:

1. BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)
2. CONNECT THERMOSTAT WITHOUT FAIL IN THE STARTER CIRCUIT

CONTACT DEVELOPMENT DIAGRAM

SWITCH	TERMINAL NO.	VALVE POSITION
OTS	1–2	OFF AT OVER TORQUE DURING OPENING TRAVEL
	5–6	
	3–4	ON AT OVER TORQUE DURING OPENING TRAVEL
	7–8	
CTS	9–10	OFF AT OVER TORQUE DURING CLOSING TRAVEL
	13–14	
	11–12	ON AT OVER TORQUE DURING CLOSING TRAVEL
	15–16	
OLS–1	17–18	
	21–22	
	19–20	
	23–24	
CLS–1	25–26	
	29–30	
	27–28	
	31–32	
OLS–2	33–34	
	37–38	
	35–36	
	39–40	
CLS–2	41–42	
	45–46	
	43–44	
	47–48	

FULL OPEN | a | INTERMEDIATE | b | FULL CLOSE

INDICATES CONTACT CLOSED

INDICATES CONTACT OPEN

CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC

REV	DATE	CHED	APPD	DESCRIPTION
11	09.09 2000			CONTACT DEV. FIG.ADDED.

365-139

BHARAT HEAVY ELECTRICALS LTD.
UNIT: HIGH PRESSURE BOILER PLANT.
TIRUCHIRAPALLI 620014.

DRAWN N.P.ESWAR
CHECKED K.ARUNACHALAM
APPROVED P.LOGANATHAN
DATE 09.09.2000

TITLE
INTERNAL WIRING DIAGRAM
FOR
ELECTRICAL VALVE ACTUATORS (AC)
(DRAWN FOR INTERMEDIATE POSITION OF VALVES)

DRAWING No. 4-V-MISC-90271 REV 11

RETRACED WITH REVISION 11

VOLUME : IIF/1

SECTION-III

TECHNICAL SPECIFICATION FOR ELECTRIC MOTOR ACTUATORS

1.00.00 SCOPE

1.01.00 This Section covers the general requirements of Electric Motor Actuators for valves, dampers and gates.

1.02.00 All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification.

2.00.00 STANDARDS

2.01.00 All electrical equipment shall conform to the latest applicable IS, ANSI and NEMA Standards, except when stated otherwise herein or in driven equipment specification.

2.02.00 Major standards, which shall be followed, are listed below. Other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed

i) IS-9334

ii) IS-325

3.00.00 SERVICE CONDITIONS

3.01.00 The actuator shall be suitable for operation in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash.

3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the general specification.

3.03.00 For actuator motor installed outdoor and exposed to direct sun rays , the effect of solar heat [manufacturer to decide] shall be considered or overhead shed shall be provided locally to avoid direct sun rays.

4.00.00 RATING

4.01.00 For isolating service, the actuator shall be rated for three successive open-close operation of the valve/damper or 15 minutes, whichever is longer.

4.02.00 For regulating service, the actuator shall be suitably time-rated for the duty cycle involved with necessary number of starts per hour, but in no case less than 150 starts per hour.

5.00.00 **PERFORMANCE**

The actuator shall meet the following performance requirements:

5.01.00 Open and close the valve completely and make leak-tight valve closure without jamming.

5.02.00 Attain full speed operation before valve load is encountered and impart an unseating blow to start the valve in motion (hammer blow effect).

5.03.00 Operate the valve stem at standard stem speed and shall function against design differential pressure across the valve seat.

5.04.00 The motor reduction gearing shall be sufficient to lock the shaft when the motor is de-energised and prevent drift from torque switch spring pressure.

5.05.00 The entire mechanism shall withstand shock resulting from closing with improper setting of limit switches or from lodging of foreign matter under the valve seat.

6.00.00 **SPECIFIC REQUIREMENT**

6.01.00 **Construction**

6.01.01 The actuator shall essentially comprise the drive motor, torque/ limit switches, gear train, clutch, hand wheel, position indicator/ transmitter, in-built thermostat for over load protection, space heater and internal wiring. Actuator shall be non integral type.

6.01.02 The actuator enclosure shall be totally enclosed, dust tight, weather-proof suitable for outdoor use without necessity of any canopy.

6.01.03 All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.

6.01.04 The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.

6.02.00 **Motor**

6.02.01 The drive motor shall be three phase, squirrel cage, induction machine with minimum class B insulation and IPW-55 enclosure, designed for high torque and reversing service. Canopy shall be provided for outdoor service.

6.02.02 The motor shall be designed for full voltage direct on-line start, with starting current limited to 6 times full-load current.

6.02.03 The motor shall be capable of starting at 85 percent of rated voltage and running at 80 percent of rated voltage at rated torque and 85 percent rated voltage at 33 percent excess rated torque for a period of 5 minutes each.

6.02.04 Motor leads shall be terminated in the limit switch compartment.

6.02.05 Motor actuators for valves/dampers shall be non-integral type with separate starter units and operable from remote.

6.02.06 Earthing terminals shall be provided on either side of the motor.

6.03.00 **Limit Switches**

Each actuator shall be provided with following limit switches: -

6.03.01 2 torque limit switches, one for each direction of travel, self-locking, adjustable torque type.

6.03.02 4 end-of-travel limit switches, two for each direction of travel.

6.03.03 2 position limit switches, one for each direction of travel, each adjustable at any position from fully open to fully closed positions of the valve/damper.

6.03.04 Each limit switch shall have 2 NO + 2 NC potential free contacts. Contact rating shall be 5A at 240V A.C. or 0.5A at 220V D.C.

6.04.00 **Hand Wheel**

Each actuator shall be provided with a hand wheel for emergency manual operation. The hand wheel shall declutch automatically when the motor is energized.

6.05.00 Position Indicator/Transmitter

The actuator shall have:

6.05.01 One (1) built-in local position indicator for 0-100% travel.

6.05.02 One (1) position transmitter, potentiometer type, for remote indicator.

6.06.00 **Space Heater**

A space heater shall be included in the limit switch compartment suitable for 240V, 1 phase, 50 Hz supply.

6.07.00 **Wiring**

All electrical devices shall be wired up to and terminated in a terminal box. The internal wiring shall be of sufficient size for the power rating involved but in no case less than 1.5 Sq.mm copper. All wiring shall be identified at both ends with ferrules. All wires shall be fire resistance type.

6.08.00 **Terminal Box**

The terminal box shall be weather proof, with removable front cover and cable glands for cable connection. The terminal shall be suitable for connection of 2.5 Sq.mm copper conductor.

7.00.00 **ACCESSORIES**

As required for the driven equipment, the actuator shall be furnished with starting equipment mounted on the actuator. This shall include:

7.01.00 One (1) triple pole MCCB for local isolation near the actuator

7.02.00 One (1) reversing starter with mechanically interlocked contactors, 3 thermal overload relays, 2 NO + 2 NC auxiliary contacts for each contactor.

7.03.00 One (1) remote-local selector switch.

7.04.00 CLOSE-STOP-OPEN oil tight push buttons with indication lights.

7.05.00 415/240 V or 415/110V control transformer with primary protected by fuse & secondary protected by Miniature Circuit Breaker (MCB).

8.00.00 **TEST**

The actuator and all components thereof shall be subject to tests as per relevant Standards. In addition, if any special test is called for in equipment specification, the same shall be performed.

9.00.00 **DRAWINGS, DATA & MANUALS**

9.01.01 To be Submitted with Bid

Data sheet for each type of actuator shall be furnished along with internal wiring diagram, suggested control schematic and torque limit switch contact development and manufacturer's catalogues.

9.01.02 To be Submitted after Award of Contract

a) Actuator Data Sheet

b) Internal wiring diagram and suggested control schematic

c) Torque switch and limit switch contact development

d) Manufacturer's Catalogue

e) Instruction manual indicating clearly the installation methods, check ups and tests to be carried out before commissioning of the equipment.

f) Any other relevant drawings, documents or data necessary for satisfactory installation , operation and manufacturing.

9.02.00 The Bidder may note that the drawings, data and manuals listed herein are minimum requirements only. The Bidder shall ensure that all other necessary write-ups, curves and information required to fully describe the equipment are submitted with his bid.

SPECIFICATION FOR FIELD INSTRUMENTS

1.00.00 **FIELD INSTRUMENTS**

This section provides general hardware guidelines for field instruments and equipment to be supplied under this specification.

1.01.00 Pressure Transmitter

01.	Working Principle	:	Smart (HART Compatible)
02.	Type	:	2 - Wire
03.	Output Signal	:	4-20 mA DC.
04.	Signal Processing	:	Silicon solid state electronic circuitry
05.	Measuring Element	:	Capsule / Diaphragm
06.	Element material	:	AISI-316 (Stainless Steel) or better
07.	Static Pressure	:	150 % of maximum span continuously, without affecting the calibration.
08.	Turn-down ratio	:	60: 1.
09.	Span and Zero	:	Locally adjustable non-interacting. Facility for elevation and suppression by 100% of span
10.	Enclosure Class	:	IP-65
11.	Output Indicator	:	LCD
12.	Nameplate	:	Tag number, service engraved in SS tag plate
13.	Body	:	Forged Carbon Steel for air and flue gas application and SS for other application.
14.	Operating Voltage	:	16 - 48 Volts D.C.
15.	Load	:	600 Ohms (min.) at 24 Volts D.C.
16.	Ambient Temperature	:	0 - 50 ^{O}C
17.	Performance:		
	i) Accuracy	:	± 0.1% of Span or better
	ii) Repeatability	:	± 0.05% of Span or better
	iii) Response time	:	100 msec or better
18.	Sealing/Isolation	:	Extended diaphragm with 5 meters SS armoured capillary for viscous fluid applications.
19.	Accessories	:	a) Universal mounting bracket suitable for 2” pipe mounting. b) High tensile carbon steel U- bolts. c) Siphon for steam and hot water services. d) ½” NPT 2-valve stainless steel manifold, constructed from SS316 bar stock. e) Companion flange with nuts, bolts and gaskets.

f) ½" NPT cable gland

1.02.00 Differential Pressure Transmitter / Flow transmitter

01.	Working Principle	:	Smart (HART compatible)
02.	Type	:	2-Wire
03.	Output signal	:	4-20 mA DC.
04.	Signal Processing Unit	:	Silicon solid-state electronic circuitry
05.	Measuring element	:	Capsule/Diaphragm
06.	Element material	:	AISI-316 (Stainless Steel) or better
07.	Static Pressure/ Overload Pressure	:	Maximum line (or static) pressure on either side without permanent deformation or loss of accuracy
08.	Turn-down ratio	:	60 : 1 minimum
09.	Span and Zero	:	Locally adjustable, non-interacting
10.	Enclosure class	:	IP-65
11.	Zero suppression / elevation	:	At least 100% of Span
12.	Output Indicator	:	LCD type
13.	Nameplate	:	Tag number and Service engraved in SS tag plate
14.	Body	:	Forged Carbon Steel for air and flue gas application and SS for other application
15.	Ambient temperature	:	0 - 50 ^{O}C
16.	Operating Voltage	:	16 - 48 Volts DC
17.	Load	:	600 Ohms (min.) at 24 Volts DC
18.	Performance:-		
	i) Accuracy	:	±0.1 % of span or better
	ii) Repeatability	:	± 0.05 % of span or better
	iii) Response time	:	100 msec or better
19.	Sealing / Isolation	:	Extended diaphragm with 5 meters SS armoured capillary for viscous fluid applications.
20.	Accessories	:	a) Universal mounting bracket suitable for 2" pipe mounting. b) High tensile carbon steel U-bolts. c) Siphon for steam and hot water services. d) Companion flange with nuts, bolts and gaskets. e) ½" NPT cable gland

f) ½" NPT generally 5-valve stainless steel manifold, constructed from SS316 bar stock. 3 valve manifold for DP application in flue gas and air.

1.03.00 Displacer Type Level Transmitters

01.	Type		:	Smart (HART compatible)
02.	Stages of operation		:	Continuous
03.	Material -			
	i)	Displacer	:	AISI 316 SS
	ii)	Suspension wire	:	AISI 316 SS
	iii)	Torque tube housing	:	Carbon steel or SS as per application
	iv)	Torque tube	:	Inconel
	v)	Displacer chamber	:	CS or SS as per process application
	vi)	Transmitter Housing	:	Die cast aluminium or better
04.	Operating Voltage		:	16-48 Volts D.C.
05.	Transmission		:	2-wire
06.	Output Signal		:	4-20 mA DC.
07.	Signal processing		:	Solid-state electronic circuitry
08.	Static / overload pressure		:	Maximum static pressure without permanent deformation or loss of accuracy.
09.	Turn-down ratio		:	10 : 1 or better
10.	Zero & Span		:	Easily accessible (local zero & span adjustment and non-interactive type)
11.	Enclosure Class		:	IP-65
12.	Output Indicator		:	LCD type
13.	Nameplate		:	Tag number and Service engraved in stainless steel tag plate
14.	Ambient Temperature		:	0 - 50 ^{O}C
15.	Load Impedance		:	600 Ohms at 24 Volts (minimum)
16.	Process Connection		:	2" Companion flange with nuts, bolts and gaskets
17.	Performance -			
	Accuracy		:	$\pm$ 0.5 % of span or better
18.	Accessories		:	a) Counter Flange, nuts, bolts, gaskets etc. b) Weights for 5 point calibration of instruments. c) Vent and drain plugs d) Special calibration tool/configurator,if any. e) ½"NPT cable gland

	19.	Preferred Features	:	a) Test plug connection and cutout terminals physically separated from other electronics. b) Electronic Damping facility (adjustable).
1.04.00		Mass Flow meter		
1.04.01		Sensor		
	01.	Measuring Principle	:	Coriolis Mass flow.
	02.	Primary Element	:	Flow Tube of 316SS or better
	03.	Heating Arrangement	:	Integral.
	04.	Temperature Control	:	For heavy fuel oil application.
	05.	Process Connection	:	Flanged of rating as per process requirement.
	06.	Drain	:	Self-draining facility
	07.	Enclosure	:	Stainless steel
	08.	Accessories	:	Counter flanges, Mounting nuts, bolts, gaskets etc.
1.04.02		Transmitter		
	01.	Measured quantities	:	Mass Flow rate, Total Mass Flow, Density.
	02.	Input Signal Processing	:	Digital Processing.
	03.	Display	:	Digital Display (LCD).
	04.	Output	:	2 off. isolated 4-20mA DC output.
	05.	Load	:	< 750 ohms.
	06.	Power supply	:	240V AC, 50 Hz.
	07.	Turn Down	:	100:1
	08.	Accuracy	:	$\pm$ 0.2 % of measured value
	09.	Housing	:	IP 65
	10.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
	11.	Accessories	:	a) Handheld configurator b) Mounting U-bolts, nuts, bolts, prefab cable etc. c) ½"NPT cable gland
1.05.00		Pressure Gauge and Differential Pressure Gauge		
	01.	Type	:	Bourdon/Bellows/Diaphragm
	02.	Sensing & Socket	:	AISI-316 SS
	03.	Movement Material	:	AISI-304 SS
	04.	Case Material	:	Stainless steel. IP-65.
	05.	Dial Size	:	Generally 150 mm
	06.	Scale	:	Black lettering on white in 270 ^{O} arc.

	07.	Window	:	Shatterproof glass
	08.	Range Selection	:	Normal process pressure: 50~70 % of range
	09.	Over-range Protection	:	125% of maximum range by internal stop. External stop at zero.
	10.	Adjustment	:	Micrometer screw for zero. Internal micrometer screw for range.
	11.	Element Connection	:	Argon welding
	12.	Process Connection	:	1/2" NPT (M) Bottom for local, back for panel mounting.
	13.	Performance	:	Accuracy of ± 1.0 % of span or better.
	14.	Operating ambient	:	0 - 50 ^{O}C
	15.	Safety Feature	:	Blow out disc /diaphragm at the back
	16.	Accessories	:	a) Snubbers and Glycerin filled for pulsating fluid applications and at pump discharge. b) Stainless steel Diaphragm seals for viscous fluids. c) 3-Way SS316 Gauge cock for pressure gauges. d) 5-valve SS316 manifold from barstock for differential pressure gauge. e) Siphons for steam and hot water services.
	17.	Applicable standard	:	IS-3624 / 1996
	18.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
1.06.00		Temperature Gauge		
	01.	Type	:	Bimetallic or gas filled.
	02.	Sensing Element Material	:	Bourdon - AISI-316 SS
	03.	Capillary Armoring	:	Stainless steel flexible
	04.	Movement Material	:	AISI 304 SS
	05.	Bulb / Stem Diameter	:	12 mm
	06.	Bulb / Stem Material	:	AISI 316
	07.	Capillary	:	Stainless Steel
	08.	Connection to well	:	½" NPT
	09.	Case Material	:	Stainless steel
	10.	Dial Size	:	150 mm in general
	11.	Scale	:	Black lettering on white in 270 ^{O} arc.
	12.	Mounting	:	Surface/Panel
	13.	Over range Protection	:	125 % of range or more

	14.	Instrument connection	:	Bottom for local and back for panel mounting.
	15.	Range	:	Normal temperature–50~70% of range.
	16.	Zero adjuster	:	Micrometer screw adjustable from front.
	17.	Window	:	Shatterproof glass.
	18.	Accuracy	:	± 1 % or better
	19.	Enclosure Class	:	IP-65
	20.	Capillary	:	5 meters (local surface)/15.0 meters (local panel) - armoured stainless steel
	21.	Compensation	:	Capillary and Case Compensation
	22.	Accessories	:	a) Forged barstock thermowell screwed as per ASME PTC code. Process connection M 33X2 (M). Material of construction of Thermowell: - SS 316: In general - Inconel: For flue gas application - Tungsten carbide: For coal mill application.
	23.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
1.07.00		Thermocouples		
	01.	Type	:	a) Type-J (Iron Constantan) / Type-K (Chromel Alumel) / Type-R (Pt.-Rhodium Pt.) / Type-S (90% Pt – 10% Rhodium). [As per application] b) Duplex c) Ungrounded
	02.	Wire gauge	:	16 AWG for Type-K, 24 AWG for Type-R
	03.	Standard	:	ANSI-MC 96.1.
	04.	Protecting Tube :-		
		i) O.D.	:	8 mm
		ii) Material	:	316-SS Seamless
		iii) Filling	:	Magnesium Oxide (Purity above 99.4%)
	05.	Response time	:	a) < 20 seconds for measurement. b) < 10 seconds for control.
	06.	Accuracy	:	± 1.1^0 C up to 300 ^{0} C & 0.4% of measured temperature range above 300 ^{0} C.
	07.	Head:		
		i) Type	:	IP-65 universal screwed type.
		ii) Material	:	Die cast aluminum or better
		iii) Terminal blocks	:	Nickel plated Brass - screw type/ silver plated

	iv)	Instrument connection to well	:	½" NPT
	v)	Cable connection	:	½" NPT gland and grommet.
	vi)	Others	:	Terminal head cover with SS chain and suitable gasket. All thermowells in the high velocity steam service shall be checked for Strouhal's frequency limit to arrive at a safe size and design of thermowells.
08.	Accessories		:	a) Adjustable nipple-union-nipple [1/2" Sch 80 X ½" NPT (M)] with thermowell connection b) Compression fittings/unions c) Flanges etc. (for flanged connections only) d) Forged barstock thermowell as per ASME PTC code. Process connection M 33X2 (M) in general or 1½" Flanged for Flue gas/Furnace/Air etc. application. Material of construction of Thermowell: SS 316: In general Inconel: For flue gas application Tungsten carbide: For coal mill application.
09.	Nameplate		:	Tag number, service engraved in stainless steel tag plate

1.08.00 Resistance Temperature Detector

01.	Type		:	Platinum (Duplex), Ungrounded
02.	Resistance		:	100 ohm at 0 ^{O}C
03.	Base		:	Wound on ceramic (anti-inductive)
04.	Wiring		:	3 /4 Wire
05.	Protecting Tube :-			
	i)	O.D.	:	8 mm
	ii)	Material	:	SS-316, Seamless
	iii)	Filling	:	Magnesium oxide (Purity above 99.4%).
06.	Response time		:	a) < 20 seconds for measurement. b) < 10 seconds for control.
07.	Calibration		:	DIN 43760
08.	Accuracy		:	± 0.5%
09.	Head :			

		i) Type	:	IP-65 universal screwed type.
		ii) Material	:	Die cast aluminum or better
		iii) Terminal blocks	:	Nickel plated Brass-screw type / silver plated
		iv) Cable connection	:	½" NPT gland and grommet.
		v) Others	:	Terminal head cover with SS chain and suitable gasket. All thermowells in the high velocity steam service shall be checked for Strouhal's frequency limit to arrive at a safe size and design of thermowells
	10.	Accessories	:	a) Adjustable nipple-union-nipple [1/2" Sch 80 X ½" NPT (M)] with thermowell connection b) Compression fittings/unions c) Flanges etc. (for flanged connections only) d) Forged/barstock thermowell as per ASME PTC code. Process connection M33X2 (M). Material of construction of Thermowell: SS 316: In general Inconel: For flue gas application Tungsten carbide: For coal mill application.
	11.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
1.09.00		Pressure Switch		
	01.	Type	:	i) Piston for high pressure application ii) Bellow / Diaphragm for low pressure application
	02.	Sensing element material	:	AISI SS-316. All other wetted part SS316.
	03.	Case Material	:	Die-cast aluminum alloy, neoprene gasket.
	04.	Setter Scale	:	Black graduation on white linear scale. Graduation 0-100% with red pointer for set points.
	05.	Over range	:	150 % of maximum pressure
	06.	Adjustments	:	a) Internal Set Point b) Differential adjustment
	07.	End Connection	:	1/2" NPT (M) bottom connected
	08.	Switch configuration	:	Two SPDT
	09.	Switch Rating	:	240V, 5A AC/220V, 0.5A DC

10.	Switch Type	:	Snap acting, shock & vibration proof
11.	Terminal Block	:	Suitable for full ring lugs.
12.	Cable connection	:	½" NPT conduit connection.
13.	Enclosure Class	:	IP-65.
14.	Performance	:	a) Repeat accuracy ± 1.0% b) Accuracy of Setting Indication of ± 1.5%
15.	Ambient temperature	:	0 – 50 Deg.C
16.	Nameplate	:	Tag number, service engraved in SS tag plate
17.	Accessories	:	a) Remote diaphragm seal with SS-316 capillary for viscous & corrosive application. b) Siphons for steam and hot water services. c) Retention ring and screws for surface mounting. d) 1/2" NPT 2 Valve SS-316 barstock manifold e) ½" NPT cable gland

1.10.00 Differential Pressure Switch

01.	Type	:	Bellows / Diaphragm / Piston actuated
02.	Sensing element material	:	AISI SS-316. For all other wetted part SS 316
03.	Case Material	:	Die-cast aluminum alloy with neoprene gasket.
04.	Setter Scale	:	Black graduation on white scale with 0-100% graduation and provided with red pointer for set point adjustment
05.	Over range	:	Static pressure on any one side, the other side being open to atmosphere.
06.	Adjustments	:	a) Internal set point adjustment b) Differential adjustment
07.	Process Connection	:	1/2" NPT (M) bottom / back connected.
08.	Switch configuration	:	Two SPDT
09.	Switch rating	:	240V, 5A AC/220V, 0.5A DC.
10.	Switch type	:	Snap acting type contacts, shock and vibration proof.
11.	Terminal Blocks	:	Suitable for full ring lugs for cable connection.
12.	Cable Connection	:	½" NPT conduit connection or compression gland.
13.	Performance	:	a) Repeat accuracy ± 1.0% b) Accuracy of set point Indication: ±1.5%

14.	Operating Ambient	:	0 - 50 ^{O}C (Maximum Continuous)
15.	Enclosure	:	IP-65
16.	Accessories	:	a) Snubbers for pulsating fluid application. b) Syphons for steam and hot water services. c) Retention ring and screws for surface mounting. d) 1/2" NPT 3-Valve SS-316 manifold constructed from barstock e) 1/2" NPT Cable gland
17.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
18.	Remote Seal type for special application	:	a) Silicone oil / fluorolube filled remote diaphragm seal for dirty / viscous / corrosive fluid. b) SS armoured capillary at least 3 meters each. c) Adapter flanges with nuts, bolts and gaskets for instrument and process side.

1.11.00 Level Switch

01.	Type	:	External cage float operated. Magnetically coupled.
02.	Float Material	:	AISI-316 stainless steel or better
03.	Other wetted parts	:	AISI-316 stainless steel or better
04.	External Cage	:	Carbon steel / Stainless steel as per process requirements, welded type / flanged construction. Cage pressure rating shall equal or exceed the rating of the main vessel.
05.	External cage mounting	:	Side-Side.
06.	External cage connection	:	25 NB socket welded.
07.	Switch housing	:	Epoxy coated die-cast aluminum alloy with neoprene gasket conforming to IP-65.
08.	Type of switch configuration	:	2 SPDT (two nos.)
09.	Contact rating	:	5A, 240V/AC, 0.25A, 220V DC
10.	Accessories	:	a) Counter flange, nuts & bolts, suitable gasket etc.

				b) Steel globe type drain valve.
				c) ½"NPT cable gland
				d) Stainless steel nameplate with alpha-numeric engraved for service and tag.
	11.	Preferred feature	:	Switch operating point marked on cage
	12.	Mounting	:	On standpipe
1.12.00		Conductivity Type Level Switch		
	01.	Type	:	Conductivity discrimination.
	02.	Application	:	Drain pots viz. on CRH line
	03.	Mounting	:	Flanged – on external cage.
	04.	Probe MOC	:	Stainless steel with high purity ceramic.
	05.	Probe rating	:	> Maximum design pressure of vessel.
	06.	Input	:	Four independent channel with selectable switching threshold for water conductivity.
	07.	Relay Output	:	Four isolated output relays for Hi, Lo, Hi-Hi, Lo-Lo.
	08.	Contact type & rating	:	2SPDT or 1 DPDT @ 5A 30V DC.
	09.	Local Display	:	Coloured LEDs for Hi, Lo, Hi-Hi, Lo-Lo, Power & fault.
	10.	Power supply	:	Dual 240V AC, 50 Hz, 1Ph.
	11.	Enclosure	:	IP–65, corrosion resistant & wall mounting type (Explosion proof for NEC Class-1, Division-1 area).
	12.	Accessories	:	a) PTFE cable from probe to electronics
				b) Mounting accessories
				c) External cage
				d) Washer & gasket
	13	Test pressure	:	Two times rated pressure
	14.	Cable connection	:	½" NPT with cable gland
1.13.00		Orifice Plate		
	01.	Application	:	Low fluid velocity flow measurement
	02.	Design Standard	:	BS-1042, Part-I
	03.	Number of Tapings	:	As required plus one additional pair of taps
	04.	Diameter Ratio	:	Between 0.4 to 0.7
	05.	Thickness	:	3 mm for main pipe diameter up to 250 mm, 6 mm for main pipe diameter above 250 mm and 10 mm for main pipe diameter of 500 mm and above.

	06.	Document	:	Beta ratio calculation, assembly drawing and Flow vs. DP curve.
	07.	Meter run pipe	:	Same as pipe material
	08.	Accessories	:	Flanges, gaskets, nuts & bolts, root valves jack screw, meter run pipe, Drain & vent hole as per application etc..
1.14.00		Flow Nozzle		
	01.	Application	:	High fluid velocity flow measurement
	02.	Design Standard	:	ASME PTC 19.5
	03.	Number of Tapings	:	As required plus one additional pair of taps
	04.	Diameter Ratio	:	Between 0.4 and 0.7
	05.	Thickness	:	Suitable for the application
	06.	Document	:	Beta ratio calculation, assembly drawing and Flow vs. DP curve.
	07.	Meter run pipe	:	Same as pipe material
	08.	Accessories	:	Meter run pipe, nipples and root valves. (Inspection port assembly for nozzles used in plant performance purpose)
1.15.00		Gauge Glass		
	01.	Type	:	Reflex
	02.	Glass	:	Toughened borosilicate. Resistant to mechanical and thermal shocks.
	03.	Body material	:	Carbon steel / stainless steel- As per process requirements (Flanged Connection)
	04.	Pressure rating	:	Twice the maximum working pressure
	05.	Temperature rating	:	As required
	06.	Bolts and nuts	:	Rust proof alloy steel
	07.	Accessories	:	Suitable ball check valves of SS-304/316 body, gaskets, companion flange etc.
1.16.00		Power Cylinders (Pneumatic)		
	01.	Mounting Type	:	a) Fixed position mounting (End mounting).
			:	b) Trunnion mounting
	02.	Control Signal	:	4-20 mA DC to electro-pneumatic positioner. 24V DC operated solenoid valve operating on pneumatic line for open & closing purpose of on & off drive.
	03.	Supply Air	:	0-7 Kg / Cm^2.
	04.	Selection	:	Based upon thrust / torque, stroke length, angular movement, full-scale travel time, repeatability, space factor etc. Provision for air-to-open and air-to-close operation.

	05.	Casing	:	IP-65.
	06.	Accessories	:	a) Air lock relay b) Hand wheel. c) Air filter regulator with gauge. d) Volume Booster. e) Limit Switches. f) Positioner with Input and Output pressure gauges, local keypad & display. g) Solenoid Valve h) Integral non contact type position Transmitter (4-20 mA DC linear output). i) Junction box with cable gland
	07.	Fail-safe operation	:	For regulating duty- stay put against power & air fail.
	08.	Repeatability	:	Better than 0.5% of full travel.
	09.	Hysterisis	:	Less than ±1% of full travel
	10.	Operating Temp. limit	:	50 Deg. C (min.)
1.17.00		Smoke Density Analyzer		
	01.	Type	:	In-situ infra red
	02.	Principle of measurement	:	Transmission & absorption (Dual beam type)
	03.	Light source	:	Modulated high intensity LED
	04.	Display	:	Back Lit LCD
	05.	Measurement range	:	0-999 mg/m^3, 0-999 mg/Nm^3, 0-100% opacity
	06.	Measurement averaging	:	Selectable 10 sec to 60 minutes
	07.	Accuracy	:	0.2% opacity
	08.	Resolution	:	0.1% opacity
	09.	Linearity	:	0.1% opacity
	10.	Repeatability	:	0.1% opacity
	11.	Flue gas temperature	:	350 ^{O}C (max 600 ^{O}C)
	12.	Ambient temperature	:	0 - 60 ^{O}C
	13.	Operating temperature	:	Transmitter & receiver- 0-90^{O}C, Electronic unit - 70 ^{O}C
	14.	Mounting	:	Transceiver on opposite side of the duct
	15.	Analog output	:	4-20mA DC (in 500 ohm resistance) to
	16.	Alarm output	:	2 SPCO potential free rated at 230 VAC, 5A
	17.	Power Supply	:	240V AC, 50 Hz, 1 Phase
	18.	Automatic misalignment detection	:	Required

19.	Automatic compensation of lens contamination	:	Required
20.	Purge air Failure	:	Purge air to be provided from Blower unit and to be monitored for failure.
21.	Span and Zero Check	:	Automatic periodic with manual override
22.	Housing	:	Corrosion resistant painted aluminium rated at IP-65
23.	Fail safe shutter	:	Automatic fail safe shutter against power and air failure
24.	Input normalisation	:	Correction for temperature, pressure, oxygen and water vapour to be provided.
25.	Preferred Features	:	"Power Supply On" LED visible from front
26.	Accessories	:	a) Mounting pads suitable for mounting projector and receiver units on duct, flanges, etc. b) Blower unit (Purging System) with purge fail alarm at CCR c) Enclosure for electronic units & indicators d) Control unit for interface with PC based data logger
27.	Application	:	At chimney At each ESP oulet

1.18.00 SOx, NOx, CO, CO2 , O2 & Moisture Analyzer

01.	Type	:	In-situ Probe type combined analyser / Sampling extraction type.
02.	Gases to be measured	:	SOx, NOx, CO, CO_2, O_2 and Moisture
03.	Principle of measurement	:	Infrared absorption
04.	Flue gas Temperature	:	350 ^{O} C
05.	Ambient temperature	:	60 ^{O} C
06.	Mounting	:	On chimney
07.	Measurement range	:	0-3000 ppm / mg/Nm^3 for SOx, NOx, CO, O_2 and 0-25% for CO_2 and Moisture - fully selectable
08.	Units of measurement	:	PPM, mg / Nm^3 and %
09.	Power Supply	:	240V, 50 Hz, 1 Phase
10.	Local Display	:	Back lit LCD / LED
11.	Measurement averaging	:	10 sec to 60minutes (selectable)
12.	Accuracy	:	2% of measured value
13.	Repeatability	:	2% of full scale
14.	Response time	:	5 seconds or better for 95% of full scale

	15.	Zero & Span drift	:	2% per month
	16.	Calibration	:	Zero and Span calibration in manual and automatic mode. Automatic calibration interval shall be fully selectable.
	17.	Analog output	:	4-20 mA DC (in 500 ohm resistor) to for each channel
	18.	Alarm output	:	1NO + 1NC rated at 230V AC, 5A
	19.	Input normalisation	:	Required–online with pressure and temperature sensor and also provision for key pad entry of inputs
	20.	Probe material	:	Stainless Steel 316L
	21.	Enclosure	:	Corrosion resistant epoxy painted aluminium housing & enclosure rated to IP-65.
	22.	Accessories	:	a) Blower unit, tubes & fittings for calibration and purging, purge fail alarm in CCR b) Calibration gas cylinders for SO_2, NO_x CO_2, O_2 and CO filled in 10 Ltrs. Of WC carbon cylinder with necessary SS regulators with pressure & flow gauges, solenoid valve & SS tubings and SS fittings etc. as required. c) Mounting flanges, gasket etc. d) Control unit for interface with PC based data logger
	23.	Application	:	On flue gas stack.
1.19.00		Stack Gas Velocity Monitor		
	01.	Type	:	Non contact type
	02.	Measurement	:	Flue gas velocity
	03.	Principle of measurement	:	Time delay correlation of flue gas Infrared emission received by two detectors located at a distance apart on the chimney.
	04.	Flue gas Temperature	:	Up to 350 ^{O} C
	05.	Ambient temperature	:	60 ^{O} C
	06.	Mounting	:	On chimney
	07.	Measurement range	:	As required
	08.	Units of measurement	:	velocity- m/sec, flow- m^3 /sec
	09.	Power Supply	:	240V, 50 Hz, 1 Phase
	10.	Local Display	:	Back lit LCD / LED
	11.	Measurement averaging	:	10 sec to 60minutes (selectable)
	12.	Accuracy	:	2% of measured value
	13.	Linearity	:	2% of full scale

	14.	Response time	:	5 seconds or better for 95% of full scale
	15.	Zero & Span drift	:	2% per month
	16.	Calibration	:	Zero and Span adjustment
	17.	Analog output	:	4-20 mA DC (in 500 ohm resistor) to for each channel
	18.	Probe material	:	Stainless Steel 316L
	19.	Enclosure	:	Corrosion resistant epoxy painted aluminium housing & enclosure rated to IP-65.
	20.	Accessories	:	a) Blower unit, tubes & fittings for calibration and purging, purge fail alarm in CCR b) Mounting flanges, gasket etc. c) Control unit for interface with PC based data logger
	21.	Application	:	On chimney
1.20.00		Oxygen Analyzer		
	01.	Type	:	In-situ, Zirconium sensor, micro-processor-based transmitter, field repairable.
	02.	Range	:	0.1-10% / 0.25-25% by volume
	03.	Output	:	4-20 mA DC linear
	04	Probe Length	:	1800 mm (approximate depending on duct size)
	05.	Process Temperature	:	850 ^{O} C approx.
	06.	Measurement Reference	:	Instrument Air
	07.	Accuracy	:	±1% of F.S.
	08.	Response Time	:	Less than 5 (five) seconds
	09.	Amplifier Housing	:	IP-65
	10.	Calibration	:	Automatic periodic
	11.	Calibration Frequency	:	Once every 24 hours
	12.	Power Supply	:	240V, 50 Hz, 1 Phase
	13.	Material for Gas Carrying Components	:	Stainless Steel
	14.	Read Out	:	LED/LCD Local indicating meter
	15.	Protection	:	Automatic cell protection against reducing atmosphere
	16.	Alarm Facility	:	1 HI and 1 LO independently adjustable over span. Contact rating 500 mA at 220 V DC (minimum).
	17.	Preferred Features	:	a) HI and LO alarm LED visible from front. b) Power Supply On/Failure LED visible from front

	18.	Accessories	:	a) Mounting flanges, adaptor plate and protection shield b) Gasket, nuts and bolts c) Cable with conduit from cell to amplifier (as required) and other special cables (if any) d) Automatic calibration kit (complete with all accessories and standard Gas Cylinders)
	19.	Application	:	a) At each economizer outlet b) At each air preheater outlet

1.21.00 CO, NOx & Moisture Analyzer

	01.	Type	:	In-situ Probe type combined analyser
	02.	Gases to be measured	:	CO, NOx and Moisture
	03.	Principle of measurement	:	Infrared absorption
	04.	Flue gas Temperature	:	850 ^{O} C (max)
	05.	Ambient temperature	:	60 ^{O} C
	06.	Mounting	:	On duct
	07.	Measurement range	:	0-3000 fully selectable
	08.	Units of measurement	:	PPM and mg / Nm^3
	09.	Power Supply	:	240V, 50 Hz, 1 Phase
	10.	Display	:	Back lit LCD / LED
	11.	Measurement averaging	:	10 sec to 60minutes (selectable)
	12.	Accuracy	:	2% of measured value
	13.	Repeatability	:	2% of full scale
	14.	Response time	:	5 seconds or better for 95% of full scale
	15.	Zero & Span drift	:	2% per month
	16.	Calibration	:	Zero and Span calibration in manual and automatic mode. Automatic calibration interval shall be fully selectable.
	17.	Analog output	:	4-20 mA DC (in 500 ohm resistor) to for each channel
	18.	Alarm output	:	1NO + 1NC rated at 230V AC, 5A
	19.	Input normalisation	:	Required – online with pressure and temperature sensor and also provision for keypad entry of inputs
	20.	Probe material	:	Stainless Steel 316L
	21.	Enclosure	:	Corrosion resistant epoxy coated aluminium housing & enclosure rated to IP-65.

	22.	Accessories	:	a) Blower unit, tubes & fittings for calibration and purging, purge fail alarm in CCR b) Calibration gas cylinders for NO_x and CO filled in 10 Ltrs. of WC carbon cylinder with necessary SS regulator, SS gauges, SS tubings and SS fittings etc. as required. c) Mounting flanges, gasket etc.
	23.	Application	:	At economizer outlet
1.22.00		H2 + CO2 + Air Analyzer		
	01.	Type	:	Thermal Conductivity
	02.	Range Selection	:	3 ranges (H_2 in CO_2, H_2 in air and CO_2 in air)
	03.	Range	:	As required
	04.	Output	:	4-20mA DC (Isolated)
	05.	Operating ambient temp.	:	10 ^{O} C to 50 Deg. C
	06.	Power Supply	:	240V AC, 50Hz
	07.	Sample gas flow control	:	Required
	08.	Reference gas flow	:	Required
	09.	Reference gas pressure regulator	:	Required
	10.	Cell response	:	95% of change in 30 Sec.(Appox.)
	11.	Accuracy	:	2% of full scale
	12.	Repeatability	:	1% of full scale
	13.	Local Indicator	:	Indicating meter of 1% accuracy
	14.	Alarm facility	:	Dual (High & Low) independently adjustable.
	15.	Contact rating	:	0.5A at 220 V AC
	16.	Enclosure	:	Flame Proof
	17.	Accessories	:	Calibration gas, mounting accessories and others as required to be provided
	18.	Application	:	Generator Gas Purity.
1.23.00		Radar Type Level Measurement		
	01.	Type	:	Radar based on Time Domain Reflectometry
	02.	Antenna	:	Co axial / single rod type guided wave or Horn type as required for the application
	03.	Communication	:	Two wire 4-20mA DC, HART or Field Bus protocol.
	04.	Environmental temperature	:	0 – 50 ºC
	05.	Enclosure	:	Explosion proof /IP 65 as per application
	06.	Cable Entry	:	½" NPT

07.	Calibration	:	a)	Self calibration with internal reference
			b)	Zero & Span calibration
08.	Programming	:	Handheld programmer & Local keypad	
09.	Process Connection	:	Flanged /screwed	
10.	Electronic Housing	:	Epoxy painted Die-Cast aluminium alloy	
11.	Antenna / Flange assembly	:	316 SS or Hestalloy (as required)	
12.	Output Indicator	:	Digital Integral Display	
13.	Accuracy	:	5 mm or 0.1% of probe length	
14.	Accessories	:	a)	Programming tool kit
			b)	Gasket

1.24.00 Temperature Switch

01.	Type	:	Bimetallic or gas filled.
02.	Sensing Element Material	:	Bellow / Bourdon AISI SS-316
03.	Bulb Material	:	AISI SS-316
04.	Capillary	:	Stainless steel armored
05.	Movement Material	:	AISI SS-304
06.	Case material	:	Epoxy coated steel plate or die-cast aluminum alloy with neoprene gasket and clear glass where applicable cover conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
07.	Scale	:	Black lettering on white background
08.	Over range Protection	:	120 %
09.	Instrument connection	:	Bottom
10.	Switch configuration	:	Two SPDT
11.	Switch rating	:	240V, 5A AC/220V, 0.5A DC
12.	Switch type	:	Snap acting, shock and vibration-proof.
13.	Adjustability	:	Internal Set point adjustable over span range
14.	Cable connection	:	3/4" ET conduit connection or compression gland.
15.	Compensation	:	a) Capillary compensation with invar wire throughout the capillary length.
			b) Case compensation
16.	Performance :		
	i) Scale Accuracy	:	±1.0 % of full scale
	i) Repeatability	:	< 0.5 % of full range
	ii) Response time	:	Less than 40 seconds with thermowell
17.	Capillary length	:	5 meters (minimum) for local mounting/15 meters for local panel mounting.

	18. Nameplate	:	Tag number, service engraved in stainless steel tag plate
	19. Accessories	:	Mounting accessories, 3/4"ETcable gland.
1.25.00	Rotameter		
	01. Type	:	On-line up to 2". By-pass above 2"
	02. Metering tube	:	Borosilicate glass
	03. Float	:	AISI 316-SS unless the process fluid demands some other material.
	04. Body MOC	:	AISI 316-SS
	05. Scale	:	Graduated- Engraved black on white background.
	06. Process connection	:	Flanged
	07. Accuracy	:	± 2% of full scale detection or better for on-line type and ±4% of full-scale detection or better for by-pass type.
	08. Nameplate	:	Tag number, service engraved in stainless steel tag plate
	09. Accessories	:	Slip-on orifice plate of 316-SS and taps of Stainless Steel as per application requirements. Applicable SS Isolation valves and SS Range Orifice - for bypass type rotameters.
1.26.00	I/P Converter		
	01. Type	:	Electro-pneumatic (Outdoor Type)
	02. Input level	:	4-20 mA DC
	03. Output range	:	0.2 to 1.0 Kg/Sq. cm With 'Fail Freeze' feature. (i.e in case of wire snapping the last good value of pneumatic signal out put will hold for at least six hours)
	04. Split range	:	For typical application wherever required.
	05. Control Action	:	Selectable air to close, air to open and fail freeze application
	06. Supply pressure	:	1.2 to 1.6 Kg/cm^2 (1.4 typical)
	07. Max. supply pressure	:	7 Kg/ sq.cm.
	08 Response Time	:	5 Seconds for 0 to 90% output pressure
	09. Housing	:	IP 55
	10. Repeatability	:	±0.1% of span
	11. Accuracy	:	± 0.25% of span
	12. Supply pressure effect	:	Less than 1%
	13. Span and Zero adjustments	:	Screw
	14. Pneumatic connection	:	¼" NPT

15.	Stability	:	Less than 0.25% of Span / Zero for six months.
16.	Cable connection	:	¾" ET
17.	Mounting	:	Field (pipe/wall mounting)
18.	Accessories	:	Air filter regulator, mounting accessories, cable gland etc.

1.27.00 Air Filter Regulator

01.	Filter Element	:	Sintered Bronze
02.	Filter Size	:	5 microns
03.	Input Air	:	10.0 Kg/Sq. cm (maximum)
04.	Output	:	Adjustable from 0-2.0 Kg / Sq. cm or 0-7.0 Kg / Sq. cm (continuous) as applicable for I/P converter, control drives and control valve
05.	Effect of Supply	:	Maximum 0.02 Kg/Sq. cm for a change pressure variation in supply pressure of 4 Kg/Sq. cm
06.	Bowl Material	:	Metallic cover around high temperature area / clear transparent polycarbonate with metallic cover for ordinary applications.
07.	Accessories	:	2" dial size output pressure gauge
08.	Desirable Feature	:	No perceptible drop of pressure on opening the drain port.

1.28.00 Solenoid Valve

01.	Operating Principle	:	Electromagnetic (noiseless)
02.	Coil voltage rating	:	240 V AC / 220 V DC/24 V DC/110 V (as required)
03.	Ways	:	Generally 3-ways other depending on requirement
04.	Port size	:	1/4" NPT all ports
05.	Body	:	SS bar stock
06.	Trim	:	SS-316
07.	Duty	:	Suitable for continuous energization
08.	Sealing	:	Airtight and leak proof
09.	Ambient Temperature	:	0 - 50 ^{O} C
10.	Fluid Temperature	:	0-150 ^{O} C (approx.)
11.	Coil Enclosure	:	Stainless Steel
12.	Insulation	:	Class-H
13.	Coil Casing	:	IP-65 (Explosion proof for NEC Class-1, Division-1 area)
14.	Mounting	:	On pipe or on panel
15.	Cable Connection	:	3/4" ET
16.	Accessories	:	Mounting brackets, nuts and bolts

	17.	Preferred feature	:	a) Solenoid valve directly integral to actuator body shall have NAMOOR interface for uniformity b) Local indication for power
1.29.00		Sight Glass		
	01.	Type	:	Flap-type
	02.	End connection	:	Screwed / Flanged
	03.	Material:		
		a) Body	:	CS/SS as per process medium
		b) Indicator	:	Stainless steel
	04.	Sight Glass	:	Toughened Borosilicate
	05.	Gasket	:	Neoprene
	06.	Bolts & Nuts	:	High tensile steel
	07.	Hydraulic Test Pressure	:	1.5 times maximum working pressure
	08.	Accessories	:	As required
1.30.00		Flow Indicating Switch		
	01.	Type	:	On line metal tube Rotameter
	02.	End connection	:	Flanged
	03.	Material:		
		a) Body	:	CS/SS as per process medium
		b) Float	:	Stainless steel
		c) End fittings/flange	:	Stainless steel
		d) Other wetted part	:	Stainless steel
		b) Casing	:	Di cast Alluminium
	04.	Accuracy	:	+/- 2.0% of FSR
	05.	Rangeability	:	10:1
	06.	Electrical connection	:	¾" ET
	07.	Switch type	:	Snap acting hermitically sealed 2 nos. SPDT
	08.	Contact rating	:	5A, 240V AC
	09.	Protection class	:	IP-65
	10.	Accessories	:	As required

2.00.00 CLOSED CIRCUIT TELEVISION SYSTEM

2.01.00 Closed Circuit Television System

2.01.01 Closed Circuit Television System (CCTV) with all equipment and accessories shall be installed for the purpose of surveillance of major plant areas. Also, cameras shall be installed at the Main plant (TG Hall, Boiler ESP) and other common auxiliary plants.

2.01.02 The CCTV system shall meet the specific functional & design requirements towards collecting live video information from the various areas of the plant and displaying that information at monitors.

5.11.00 Technical Specifications of Conductivity Analyser

a)	Applicable standard		ASME PTC 19.11-1970 except as modified in this specification.
b)	Type:		
	i) Cell		Flow through type/ removable type (withdraw able with sealing valve)
	ii) Monitors		Electronic (Microprocessor based) indicating type with multi range facility
c)	Material :		
	i)	Cell	Epoxy resin/SS316
	ii)	Electrode	Platinised/SS316
	iii)	Monitors body	Carbon steel/Aluminum/Polycarbonate
d)	Monitor output	i)	4-20 mA D.C. with HART protocol spare out put
		ii)	4-20mA DC with HART protocol for DDCMIS Output load : 500Ω
e)	Power supply		240V, AC, 50 Hz from UPS
f)	Accuracy		± 1% of full scale span
g)	Stability		± 1% of full scale per month non-cumulative
h)	Repeatability		± 0.3% of span

i)	Annunciation contacts from monitors		
	i)	Number	2SPDT
	ii)	Type	Snap action micro switch
	iii)	Rating	5 amp, 240 V, 0.2 Amp, 220V DC
j)	Connection:		
	i)	Cell	On line/pipe mounted (ON LINE in sample table) 1/4 (Quarter) inch NPT (F) SCRD for on-line type and Three quarter (3/4) inch NPT (M) SCRD for pipe mounted.
	ii)	Monitors	flush panel mounting
k)	Electrical		Half (1/2) inch NPT (F) SCRD
l)	Accessories		i) Automatic temperature compensation in the range 0-100°C ii)Ammonia (NH3) removal equipment. iii) Sample coolers iv) Flow and pressure regulators v) SS316 impulse tubing and fittings vi) Isolation & drain valves as required vii)Other accessories as required viii)Adequate length of cables for connecting coils to monitors ix) Sample rate set valves x) Alarm settings and Alarm indications on monitor.
m)	Other particulars		Cell shall be suitable for maximum pressure of 7 kg/cm^2 and maximum temp. of 100°C
n)	Response time		$\leq$ 3 seconds

5.11.01 CONDUCTIVITY COMPARATOR

Applicable Standard	:	ASME PTC 19-11-1970 except as modified this specification
Type of cells	:	Flow through type / removable type with draw able with sealing valve)
Transmitter	:	Electronic (Micro processor based) indicating type with multi range facility pipe mounted.
Material of Cell body	:	SS316
Material of cell Electrode	:	Platinised/SS316
Output	:	4 to 20mA DC isolated with HART output